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Friction Study on Al6061 and Al6082 Alloyes

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ABSTRACT: This research aims to investigate the effects of moving speed on the friction coefficient and wear properties of aluminum alloys. (Al 6061 and Al 6082) Full sliding tests were conducted using a pin on disc experimental setup. Experiments were conducted with sliding speeds of 1.5 m/s and 2 m/s up to a distance of 1000 m under a continuous normal weight of 10 N. The coefficient of friction decreased as sliding speed rose in specimens of both alloys because there was not enough time for stronger adhesive bonding to happen at faster sliding speeds. amount of alloy 6082 wear increased with increased sliding speed, but Al 6061 alloy wear volume decreased under same test conditions. To examine wear characteristics, optical microscope pictures of disc specimens were employed.

KEYWORDS: Friction coefficient, wear area, completes sliding, and sliding speed.

I. INTRODUCTION

Coefficient of friction is not just a material property; coefficient of friction is a contact property which depends on many parameters such as material properties of contact pair, loading conditions, environmental conditions, etc. [1]. Sliding speed is one of the main parameters in generation of frictional heat when metals are sliding against each other [2]. The flash temperature at asperity contacts is more when compared to the mean contact temperature [3]. When the flash temperature reaches the melting point of the base metal, the contact asperities lessen. The coefficient of friction at high sliding speeds is less due to material softening and oxidation process. Oxidation of metal surfaces is more while the contacts are slipping more quickly than 1 m/s [4]. Giovanni Straffelini and Alberto Molinari [5] observed the increase of oxide content with increase in sliding velocity from 0.2 m/s to 1 m/s in steel contacts. Uthayakumar M. et.al. [6], Due to the existence of high stress concentration, melt wear was observed in Al-SiC-B4C hybrid composites at greater normal loads and higher sliding velocities. When moving at a speed below 1 m/s, the surface roughness affects the friction coefficient of steel contacts, however when moving at a speed greater than 1 m/s The relationship between coefficient of friction and sliding speed [7].
The emphasis of the current investigation is the coefficient of friction and wear of fully sliding components at different sliding speeds.

II. METHODS AND MATERIALS

The examples for the pins and disks were made using the aluminum alloys 6061 and 6082. Table 1 lists pertinent characteristics of the alloys Al 6061 and Al 6082. The whole sliding studies were performed using a pin on disk experimental setup with a cylinder on flat contact configuration. To undertake comprehensive sliding trials, round pins with a 3 mm radius and a 165 mm diameter and 8 mm thick disk were made. 10 N was used as the constant normal load

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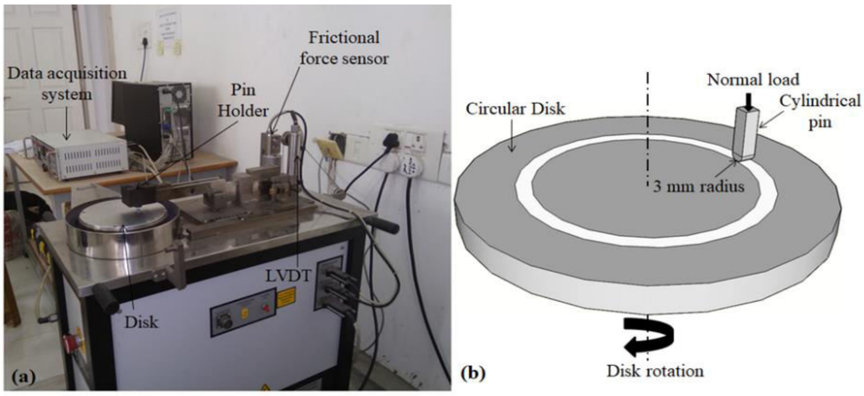
for the experiments. (< 43% of materials yield strength [8]) and sliding speeds of 1.5 m/s and 2 m/s. experiments were conducted at 33 °C ambient temperature and 86 % relative humidity. Surface roughness of disk samples was measured as Ra = 0.37 µm, Ra = 0.43 µm for Al 6061 and Al 6082 disks specimens respectively.

Table-1 Pin and disk Material mechanical properties

Material	Ultimate strength (MPa)	Tensile strength (MPa)	Elastic modulus (GPa)	Brinell Hardness
Al 6061	311	275	68	104
Al 6082	311	261	69	93

Figure 1. (a) Pin on disk experimental configuration; Figure 1. (b) Schematic diagram of cylinder on flat contact configuration

III. WEAR AND THE COEFFICIENT OF FRICTION



The frictional coefficient between two metallic contacts relies on a variety of parameters, one of which is the speed of the sliding motion. The present study focuses on Aluminum alloys' initial stability of their friction coefficient. Before a 15 m sliding distance, it was demonstrated that the coefficient of friction for the alloys Al 6061 and Al 6082 stabilized. As sliding speed was increased to 2 m/s, the coefficient of friction of aluminum alloys decreased. At 1.5 m/s sliding speed and 2 m/s sliding speed, the stabilized coefficient of friction of Al 6061 alloy was measured to be equal to 0.51 and equal to 0.49, respectively. At 1.5 m/s sliding speed, Al 6082 alloy had a coefficient of friction of 0.6, while at 2 m/s, it had a coefficient of friction of 0.48. Figure 2 (a) shows the friction coefficient evolution of Aluminium alloys during initial cycles. In both the alloys, decrease in friction coefficient was observed when the sliding speed increases because there isn't enough time for good adhesive bonding at faster sliding rates. The schematic diagram of contact asperities before and after sliding is shown in Figure 3. Lower coefficient of friction (Figure 2.(a)) the existence of an oxide layer at the beginning of the tests, as illustrated in Figure 3. (a). Subsequently, owing to the elimination of the oxide layer and a steady rise in metal to metal contact adhesion, a progressively rising coefficient of friction was seen (Figure 3.(b)).

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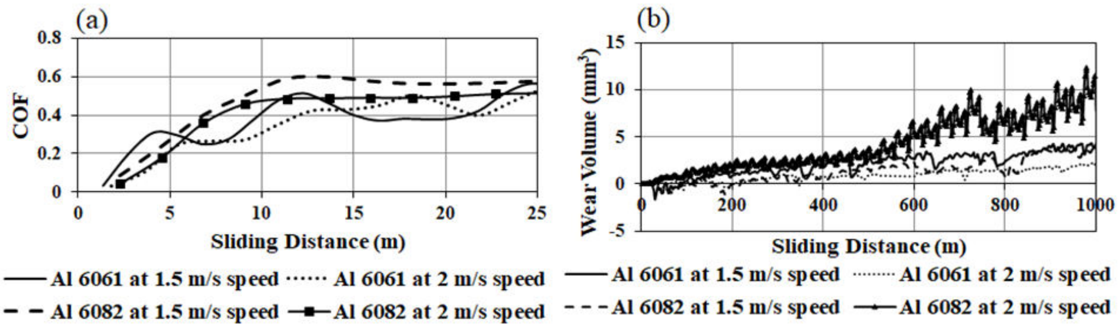
IV. RESULTS AND DISCUSSION



(a) Coefficient of friction with different sliding speed and (b) wear volume of Al 6061 and Al 6082 alloys

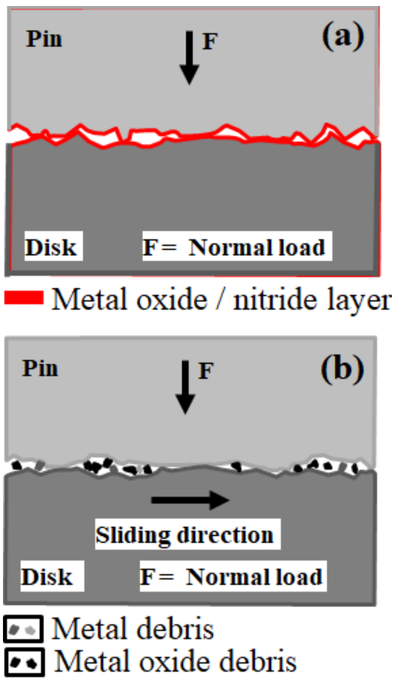


Figure 3. Schematic of point at contact interface (a) before sliding and (b) after sliding

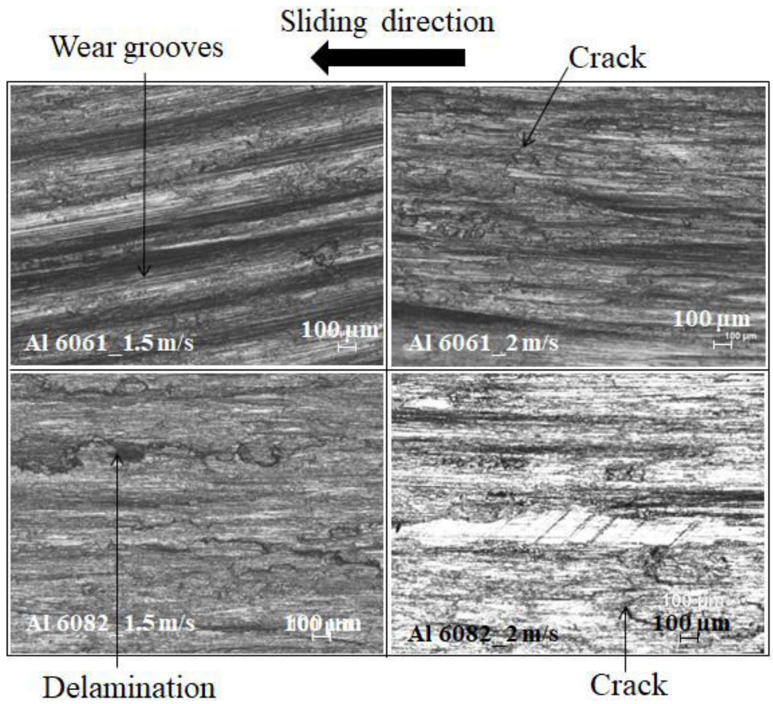


Figure 4. Optical microscopic images of aluminium alloys at 1.5 m/s and 2 m/s sliding speeds

In Figure 2. (b) The wear volume of the alloys Al 6061 and Al 6082 is shown over a 1000 m sliding distance.. In Al 6061 alloy, with increasing sliding speed, a reduction in wear volume was seen. When the sliding speed was increased from 1.5 m/s to 2 m/s, the wear volume dropped from 4.5 mm^3 to 2.4 mm3. An increase in sliding speed in the alloy Al 6082 led to an increase in wear volume. When the sliding speed rose from 1.5 m/s to 2 m/s, the wear volume increased from 4.5 mm^3 to 10 mm^3. From images obtained using optical microscope (Figure 4), wear groves were observed at lower sliding which represents adhesive wear and at higher sliding speed smothering and smearing of surfaces were observed. Both alloys showed fractures running transversely with a 2 m/s sliding speed. Contrasting Al 6082 and Al 6061 alloys comparison reveals that it is a softer material. Al 6082 alloy's reduced hardness may be the cause of the rise in wear volume with increasing sliding speed, which is why delaminating happened at 1.5 m/s and surface smearing occurred at 2 m/s. The wear volume of Al 6061 alloy decreases as sliding speed rises due to the material's hardness.

V. CONCLUSIONS

The coefficient of friction decreased in both alloys as sliding speed was increased due to insufficient adhesive forces at higher sliding speeds. Al 6061 alloy's wear volume decreased as sliding speed rose due to its hardness. The wear volume of Al 6082 material increased with an increase in sliding speed because the creation of higher flash temperatures causes the material to soften at faster sliding speeds.

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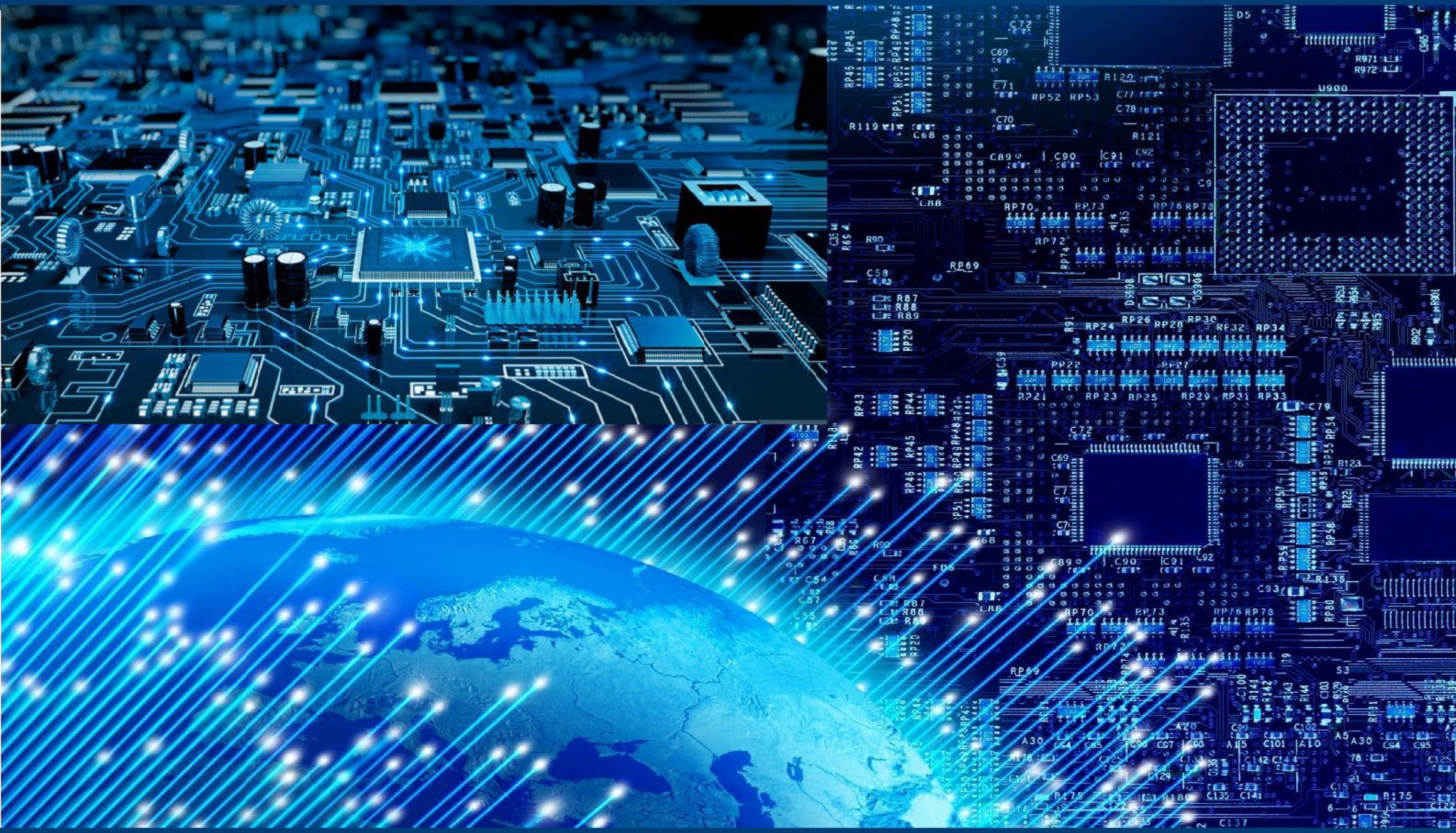

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